

Plastic Pollution - An Emerging Issue
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Abstract

Plastic has become an undeniable part of human lives all around. Plastic bags are very popular with retailers and consumers because they are cheap, strong, lightweight and water resistant for carrying goods as well as some food. Almost all people use plastic bags in daily life, but many of them don't know that these bags are the prime cause for water, soil and air pollution. It is dangerous for human, plant and animal life. The main issue with plastic arises when used plastics are disposed off. Degradation of plastics takes 50 years to an estimated one million years. There are rules passed by the governments, not to use plastic bag whose thickness is less than 40 microns. But there is no proper monitoring over this. About 60 - 100 million barrels of oil are needed every year to make plastics around the world. This paper deals with effective uses of plastic which are helpful for the prevention of environmental disaster in near future.

Key Words: Over consumption, disposal, biodegradation, environmental pollution, manual clean up, plastic consuming microorganisms.

Introduction

Plastic plays a critical role in the way present society runs and functions. Without the use of plastic products, it would be more difficult for people to conveniently access medical treatment, ship certain materials across state borders, or make a quick cup of coffee in the morning. There are various ways in which plastic affects everyday lives. Most countries have banned the usage of plastic bags due to the high degree of toxicity they come with and most citizens can understand it. But people seldom do not use plastic bags during marketing. Sellers voluntarily offer plastic bags and buyers do not refuse to use them. Thus, ban on plastic bags is hardly executed. Administrative power and regulations fail due to market forces and consumer demand. That may explain why the plastic bag was once branded the worst invention of the 20th century because it causes worldwide pollution.

A new term "white pollution," coined to describe the unsightly tumbleweed of plastic bags polluting the whole world.

Use of Plastic

i. Plastic Packaging: Plastic makes a quality packaging material that gives products the protection they need because of its flexibility to strength, durability, water resistance, size and shape. For example, when used for medical purposes, plastic packaging can keep medical instruments and equipment safe from

contamination and prevent the spread of infection. Food is often kept in plastic packages to help preserve flavour and provide convenience when storing and transporting.

ii. Building and Construction: The building and construction industry is one of the nation's largest consumers of plastics second only to packaging industry. Windows, doors, flooring, gutters, piping, insulation and plumbing fixtures - these are just some of the examples of how plastic is used for constructing both the interior and exterior of homes and buildings. Plastic can be easy to install and transport, making it a cost-effective material that is incredibly welcomed in many places.

iii. Around the House: Many of the items that are used on a daily basis are made out of plastic. From desktop computer to hair dryer, the coffee maker to the container, plastic is what keeps home running smoothly every day. Many toys are made with plastic parts, and the smoke detector that keeps family safe also consists of plastic materials.

Harmful Effects of Plastics

i. Environmental Pollution: Plastic products are responsible for causing pollution, killing wildlife, and using up the precious resources of the earth.

Plastic agricultural film waste remaining in a wide area of the soil and accumulating over a long period of time, causing the soil to harden and affecting the crops' absorption of nutrients and water. Consequently, it leads to a reduction in crop outputs.

Once plastic is used, it finds its way into waterways, rivers and seas. When they are burnt, they infuse the air with toxic gases. If these toxic gases are inhaled, there will be harmful effects on human body. Many of the chemicals used in large volumes to produce plastics are highly toxic. Some chemicals, like benzene and vinyl chloride, are known to cause cancer in humans; many tend to be gases and liquid hydrocarbons, which readily vaporize and pollute the air. Many are flammable and explosive. Even the plastic resins themselves are flammable and have contributed to numerous chemical accidents. The production of plastic emits substantial amounts of toxic chemicals (e.g. ethylene oxide, benzene and xylenes) to air and water. Many of the toxic chemicals released in plastic production can cause cancer, birth defects, damage the nervous system, blood, kidneys and immune systems. These chemicals can also cause serious damage to ecosystems.

Petroleum products are diminishing and getting more expensive day by day. Petroleum is vital for our modern way of life. It is necessary for energy requirements - for factories, transport, heating, lighting etc. Without viable alternative sources of energy yet on the horizon, if the supply of petroleum would be turned off, it would lead to, practically the entire world grinding to a halt. About 60 - 100 million barrels of oil are needed to make plastic products every year around the world. For instance, producing 14 plastics

bags could provide the same energy that a car could drive for 1 km (Australian Bureau of Statistics, 2005). Also, because they come from heating oil, the production process put out harmful emissions i.e. global warming gases. This precious, non-renewable resource should not be wasted on producing plastic products.

Plastic bag pollution in marine water bodies is one of the biggest problems faced by people today. Plastic bags do more than just polluting water; they choke wildlife, get stuck to ship propellers and get wrapped around engines.

ii. Visual pollution: Once they are used, most bags go into landfill, or rubbish tips. Each year, more and more bags are ending up littering the environment. The most important thing to know about plastic bags is that they don't decompose and they take up permanent space. They just break down into many tiny bits. These plastic bags would release chemical toxicant when they are in landfills.

The Great Pacific Garbage Patch is a floating island of debris, largely made up of plastic, including plastic bags that are lodged in the North Pacific Ocean. The area of rubbish covers an area approximately twice the size of Texas. Birds and marine animals become entangled in the plastic, suffocate and drown. Plastic does not actually biodegrade, but rather dissolves into smaller and smaller pieces of plastic. These small bits of plastic are often consumed by birds, fish and eventually, humans. In addition, as plastic degrades, it leaches toxins like Bisphenol A (BPA), which contaminate the water. NOAA has been contacted regarding cleanup of the debris directly in the garbage patch and other areas of the North Pacific but cleanup is likely to be more difficult than it may seem.

iii. Death of Animals: There are some incidents of hundreds of cows dying in Delhi because they consumed plastic. Cows and dogs mistake these bags as food and eat them along with the food. As this plastic is non-biodegradable and does not digest in their intestines, they face serious respiratory problems and die. Albatross and others birds are choosing plastic pieces because of their similarity to their own food. Albatrosses and tropicbirds circle above the line of trash of Great Garbage Patch. With little else to choose, they obviously eat plastic. The birds seemed to be picking and choosing the reds, pinks and browns, anything that looks like shrimp. In the birds' gullets researchers found red plastic particles. Greenpeace reported that a staggering 80 percent of seabird populations observed worldwide have ingested plastics. When fish consumes this plastic, its body gets poisonous and when this toxic fish is consumed, it causes infection. Plastic bags can kill coral by covering and suffocating them, or by blocking sunlight needed by the coral to survive. Nets and lines become snagged on coral and subsequent wave action causes coral heads to break off at points where the debris was attached. About 100,000 marine animals, such as dolphins, turtles, whales, penguins are killed every year due to these bags. And worse, the ingested plastic bag remains intact even after the death and decomposition of the animal. Thus, it lies around in the landscape where another victim may ingest it.

As a result, humankind could eventually become victims of toxic chemicals from plastic bags through the food chain. Nearly eight among ten new born babies have measurable level of plastic chemicals in their body.

iv. Degradation: One of the worst environmental effects is plastics are made of polyethylene and are non-biodegradable. Since plastics belong to a chemical family of high polymers, they are essentially made up of a long chain of molecules containing repeated units of carbon atoms. Because of this inherent molecular stability (high molecular weight), plastics do not easily breakdown into simpler components. The decomposition takes about 50-1000 years. Commercially available plastics (polyolefins like polyethylene, polypropylene, etc.) have been further made resistant to decomposition by means of additional stabilizers like antioxidants. Thus, unless the plastic is specially designed to decompose in the soil, such materials can last a very long time because the chemical bonds that hold the molecules together are often stronger than nature's power to take them apart. This means that soil microorganisms that can easily attack and decompose things like wood and other formerly living materials cannot break the various kinds of strong bonds that are common to most plastics.

The process involved modeling plastic decomposition at room temperature, removing heat from the plastic and then using a liquid to extract the BPA and PS Oligomer that are not found naturally, thus must have been created through the decomposition of the plastic. Once degraded, the plastic was shown to release three new compounds not found in nature: styrene monomer (SM), styrene dimer (SD) and styrene trimer (ST). While SM is already a known carcinogen, SD and ST are suspected to be as well.

Plastics are not metabolized subsequent to ingestion since they are polymers. On the other hand, low molecular compounds such as PS oligomer or BPA from plastic decomposition are toxic.

Samples of sea sand and seawater collected from Europe, India, Japan and the Pacific Ocean were found to be contaminated, with up to 150 parts per million of some of these components of plastic decomposition. This depends upon the plastic (polymer) and the environment to which it is exposed.

Production of Plastic

Since its discovery by Alexander Parkes in 1862 and commercial production by John Wesley Hyatt in 1868, it has been one of the most used commodities in the world. The plastics industry really began in 1868. John Wesley Hyatt, a young American printer was searching for a new material to be used as a substitute for ivory for making billiard balls. This new plastic was called Bakelite. Production of plastics has increased over 2000% since Bakelite was first produced.

One manufacturing process that is commonly used for creating plastic parts is called plastic injection molding. During this process, raw plastic material is melted and injected into a mold through an

injection molding machine, then cooled and ejected in a few seconds. Injection molding can be used for a wide variety of materials, including acrylic, polycarbonate, polyolefin etc. Millions of dollars are spent yearly in plastics research, trying to find new plastics and to improve the existing ones. The world's annual consumption of plastic bags was 5 million tons in the early 50's. Of the 260 million tons of plastic the world produces each year, about 10 percent ends up in the ocean (according to a Greenpeace Report - Plastic Debris in the World's Oceans, 2006). Seventy percent of the mass eventually sinks, damaging life on the seabed. The rest floats in open seas, often ending up in gyres, circular motion of currents, forming conglomerations of swirling plastic trash called garbage patches, or ultimately ending up washed ashore on someone's beach.

In India, plastics consumption grew exponentially in the 1990s. During the last decade, the total consumption of plastics grew twice as fast (12% p.a.) as the gross domestic product growth rate based on purchasing power parities (6% p.a.). The current growth rate in Indian polymer consumption (16% p.a.) is clearly higher than that in China (10% p.a.) and many other key Asian countries. The average Indian consumption of virgin plastics per capita reached 3.2 kg in 2000/2001 (5 kg if recycled material is included) from a mere 0.8 kg in 1990/1991. This is one sixth of the world average (18 kg/capita). This consumption led to more than 5400 tonnes of plastics waste being generated per day in 2000/2001 (2 million tonnes per annum). The consumption of plastics will increase about six fold between 2000 and 2030. The share of polyolefin in India will remain at about 60%, a percentage comparable to that of Western Europe. Forty-seven percent of the total plastics waste generated is currently recycled in India; this is much higher than the share of recycling in most of the other countries. The recycling sector alone employs as many people as the plastics processing sector, which employs about eight times more people than the plastics manufacturing sector. Due to the increasing share of long-life products in the economy, and consequently in the volume of waste generated, the share of recycling will decrease to 35% over the next three decades. The total waste available for disposal (excluding recycling) will increase at least 10-fold up to the year 2030 from its current level of 1.3 million tonnes.

The problem is further exacerbated by the developed countries shipping off their plastic waste to developing countries like India. An estimated 14 billion pounds of plastic waste is dumped in the ocean every year. Almost every piece of plastic ever made still exists today.

Recommendations

Single-use bags have become obvious way of life that it seems as if people simply cannot do without them. There are many healthy plastic alternatives like paper bags, cotton bags, jute bags, tote bags and bottles which are made of environment friendly products. True long term solution can be seen if suitable biodegradable plastics are developed. Degradation of polymers is dependent on their chemical structure. Natural polymers e.g. cellulose, proteins may meet the biodegradability requirements but do not

assure the inertness requirement. Synthetic polymers with suitable degradable units in their structures like hydroxy, urea, urethane, ester etc. can open up the possibility of degradation, keeping adequate inert property.

The simplest, yet highly effective, action is the manual clean up of the beaches, coasts, rivers, lands and estuaries. National and international manual clean-up operations of shorelines and sea floor are in existence. On an international level, the International Coastal Cleanup (ICC) was installed. The International Coastal Cleanup (ICC) engages the public to remove trash and debris from the world's beaches and waterways, to identify the sources of debris, and to change the behaviors that cause pollution. The Clean Up the World program is run in conjunction with UNEP. It engages more than 40 million people from 120 different countries in clean up operations.

Two high school students [Daniel Burd (2008) and Tseng I-Ching (2009)], who discovered plastic-consuming microorganisms, might have found groundbreaking solutions.

There have been several successful bacteria based solutions developed at the Dept. of Biotechnology in Tottori, Japan and the Dept. of Microbiology at the National University of Ireland, but both apply only to styrene compounds. The University of Wisconsin isolated a fungus capable of biodegrading phenol-formaldehyde polymers previously thought to be non-biodegradable in 2004. The new plastics invented by the scientists at the University of Southern Mississippi (USM), are made of polyurethane that has been modified by the incorporation of PLGA [poly (lactide-co-glycolide)], a known degradable polymer used in surgical sutures and controlled drug-delivery applications. When exposed to seawater, the plastics degrade via hydrolysis into nontoxic products.

People should not wait for a law and instead of using plastic. They should use other sources. They should complain to municipality officials, if plastic bag is being used in any shop. As it is major issue, only law cannot change it.

Plastic recycling is the only way to ensure the better use of plastic. A change in behavioral propensities to over-consume plastics, discard and thus pollute, need to be promoted to the fullest.

A new waste strategy, namely the concept of Zero Waste, has been widespread. Such a strategy encompasses waste reduction, reuse and recycling as well as producer responsibility. According to a Greenpeace report, strategies to achieve Zero Waste are adopted throughout the world, in industrialized countries and in less developed countries. Environmental Chemistry Laboratory of the California Department of Toxic Substances Control (DTSC), is currently analyzing some of the plastic marine debris collected at the Great Garbage Patch by Project Kaisei scientists, and explores the potential of converting the plastic collected into new material e.g. fuel, clothing, or simply more profitable plastic. Numerous industries, such as fashion, are already increasingly focusing on new green materials as a base for their

offered products, encouraging a way of life and cultural change toward better choices and awareness of the environment.

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